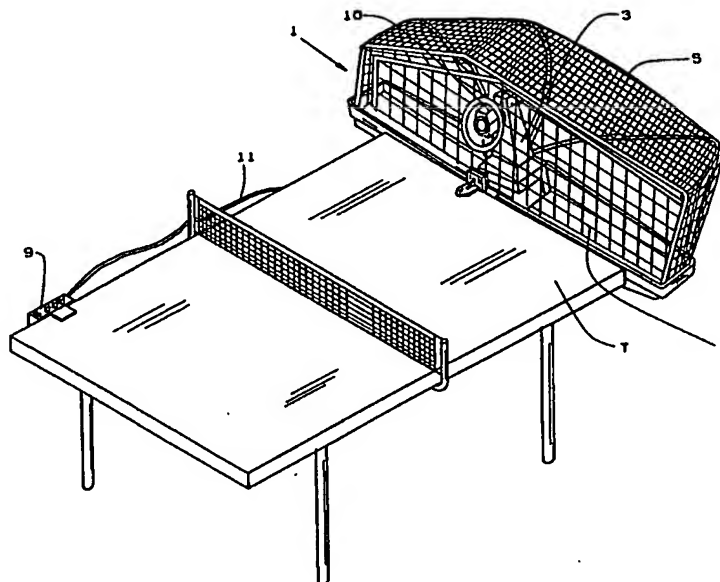




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(54) Title: TABLE TENNIS BALL SERVER ROBOT AND NET**(57) Abstract**

A table tennis ball serving assembly (1) is mounted to a table by a quick release, foldable net attachment assembly (5). Server (1) includes a container (13) and a robot server (3) mounted therein. Trough assembly (19, 21) is mounted to and extends out laterally from the container (13). Net assembly (5) surrounds the robot server (3). Net assembly (5) contains a rear ball-impervious net (41) and a forward net (53) designed to allow balls striking the forward net (53) at a predetermined velocity to pass through, strike the rear net (41) and drop into trough assembly (19, 21). Balls striking the forward net (53) with insufficient velocity drop into the trough assembly (19, 21). Side wing nets (8') may be provided to extend along each side to the mid-point of the table. A pair of removable ball dams (25) in the trough assembly create a ball storage area. Holes (24) of predetermined size in the dams serve as a gauge for ball sizing. The robot server (3) includes a robot (207) that can be removably mounted to the front or rear of a ball holding tray or container (203).

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TABLE TENNIS BALL SERVER ROBOT AND NET

Background of the Invention

This invention relates to a robot server assembly for serving table tennis balls, and more specifically to a robot server assembly that is collapsible, portable, and employs a unique dual net feature to capture balls hit back at the robot so as to allow the balls to be fed to the server and reused.

Table tennis is a popular, competitive and recreational sport. The object of the game is to have a player on each side of the table so that each player can serve, return and volley a table tennis ball. Often, however, a player may wish to play the game of table tennis without another player. To that end, various table tennis ball serving devices or robots have been developed. The devices serve the ball to the player so that the player can return the shot in the direction of the robot. Many of the devices known to the art, however, lack functional useful or effective means of capturing the ball returned by the human player and recycling the ball to the robot server.

For example, U.S. Patent No. 2,087,575 to Littell et al. describes a device that can be employed in table tennis, for example, for ejecting light weight balls. The device includes an overhead supply means, typically in the form of an overhead hopper which is fed by a conveyor system having a series of ball carrying members mechanically mounted for movement in a continuous loop.

U.S. Patent No. 2,508,461, to Lemon describes an apparatus for ejecting table tennis balls and employs pressurized air, as from a home vacuum cleaner, to propel and eject balls from a conduit. A gravity fed collector

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box is provided for introducing a ball into a lower portion of the conduit. The Lemon device provides no control on the entrance of the balls, and failure of the balls to feed properly can result in a loss of air pressure particularly as a plurality of balls are introduced into the system.

U.S. Patent No. 3,917,265, to Schrier, is another pneumatic ball ejecting machine including pneumatic means for transporting the balls from a collection source, for loading the balls to an ejection means and for ejecting the balls. Again, maintenance of air pressure in the device is critical. Furthermore, the device does not disclose an effective means for catching the return shot and feeding it to the ejector mechanism.

U.S. Patent No. 4,116,438 to Berliner, describes a device for throwing table tennis balls, having a mechanical throwing means including two flexible, thin throwing discs extending generally parallel with respect to each other for grasping a table tennis ball between them and ejecting it along a guide. The balls are returned to the serving disc by pneumatic means.

U.S. Patent No. 2,793,636 to Cook, describes a fan operated device as does U.S. Patent No. 3,911,888 to Horvath.

U.S. Patent to Augustine, No. 3,989,242, discloses a device for ejecting conventional tennis balls and also discloses an enclosure means including netting for catching served balls hit by a player.

My own U.S. Patent to Newgarden, No. 3,794,001, describes a relatively simple device for imparting variations in the amount of spin applied to a ball being served by the server. The disclosure of my patent is intended to be incorporated herein by reference.

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I am also a joint inventor of U.S. Patent Nos. 4,844,458; 4,854,588; 4,917,380; and 5,009,421 which discloses a portable table tennis serving device including a robot server and a ball capture net. This device employs the use of one collapsible net which cooperates with the robot so that returned balls are fed automatically to the robot. A folding net structure is also employed for attachment to a table tennis table and for feeding balls to a robot ball server. The single net structure includes a plurality of arms extending radially from a central member and netting suspended between the arms. The netting has a lower edge which is cooperatively connected with a trough device for receiving balls that fall from the netting. The trough is disposed to feed the balls to the robot serving device. The disclosures in the above described patents are incorporated by reference herein.

It can be seen that, for the most part, the robot serving devices of the prior art do not disclose ball catching mechanisms. Those table tennis balls serving assemblies which do include catch nets commonly employ a single net design where the ball strikes the net and drops into a trough so that the ball can be fed back to the robot.

Several problems are involved with such ball catching assemblies of the prior art. First of all, such devices employ a standard single net construction. The net is suspended behind the robot serving device. When the robot serving device serves the ball, the player can strike the ball back at the net. However, a returned ball that strikes the single net configuration under high velocity can bounce off of the net back onto the playing surface, or can carom off of the net onto the floor. The prior art single net configurations are more convenient than no

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catch net at all; however, they are not entirely effective at stopping all shots for capturing balls and feeding them back to a robot server. Also, the robot server is often mounted toward the front of the device so that it protrudes out of the netting and is precariously close to the table itself. With such designs, the returned balls often strike the exposed robot and bounce out of play. Moreover, the robot can intrude upon table space required for the game.

Robots work best with table tennis balls of the proper diameter and near perfect roundness. Mishappened or large balls can cause the robot to jam or malfunction and cause excessive wear. Robot assemblies of the prior art do not provide a means for eliminating bad balls before loading them in the devices.

Furthermore, although the nets of the previous designs are intended to be collapsible, or foldable, the designs do not allow them to be completely folded into a convenient configuration for carrying. Even when folded, the nets of the prior art assembly extend outward from the base of the robot so as to be inconvenient for storage. Assemblies known to the prior art have awkward and complex mechanism for attaching the assembly to the table. The prior art assemblies are not designed for ease of storage and carrying and lack effective means for keeping all components of the assembly, as well as the table tennis balls used with the assembly, together in one group and as compact unit when not in use.

Summary of the Invention

It is therefore an object of the present invention to provide a table tennis ball serving assembly that employs a two-net configuration so as to completely trap any balls that strike the assembly and drop the balls into a return mechanism.

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Another object of the invention is to provide a robot serving assembly that is completely collapsible and foldable for carrying or storage.

Another object of the invention is to provide an assembly that employs a simple, quick release attachment mechanism that can be folded out of the way for carrying and storage.

A further object of the invention is to provide a table tennis robot serving device assembly that employs the use of ball dams so as to consolidate the table tennis balls for convenient carrying or storage.

A still further object of the invention is to provide an assembly that employs a go/no-go gauge means with which the user can gauge the size and shape of the table tennis balls used in the assembly so that any mishappened or oversized balls can be removed from the assembly.

It is another object of the present invention to provide a simple robot server assembly containing a tray designed to hold a plurality of balls for use by the robot server mounted therein.

Another object of the invention is to provide a robot server assembly wherein the robot can be mounted within the ball tray.

A still further object of the invention is to provide a robot server assembly wherein the robot server can accept balls from the front.

Another object of the invention is to provide a robot server assembly wherein the server can receive balls from the rear.

In accordance with the invention generally stated, the robot serving assembly of the present invention employs a base container and a robot removably mounted to the rear thereof so that the lower front portion of the robot can receive table tennis balls pooled in the base

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container. The assembly has a net structure with arms pivotably mounted on the rear of the base container so that the arms can be fanned out with netting suspended between the arms for surrounding the robot. The assembly employs a separate trough assembly that cantilevers horizontally from the base container and is below yet is cooperatively connected to the net so as to capture balls that are stopped by the net and for feeding balls to the robot server. The assembly further employs a forward net suspended in front of the net assembly which is designed to allow a table tennis ball striking the forward net at a predetermined velocity to pass through the forward net, thereby causing that ball to lose velocity and fall into the trough. The assembly also contains a quick release attachment mechanism which is foldable for easy storage. In an alternative embodiment, the assembly contains a tray which is designed to hold a plurality of balls. A robot server is removably mounted within the tray either on the back portion of the tray, so that the robot server can receive balls from the front, or mounted on the front of the tray so that the robot server can receive balls from the rear. The tray has a quick release mounting mechanism by which the assembly can be mounted to the end of the table. The mounting mechanism is hingedly attached to the tray so that the mounting mechanism can be folded upwardly and out of the way for carrying or storage. The assembly has an optional mechanized panning device which can be mounted on the top of the robot, thereby giving the robot ball panning ejection capabilities. Furthermore, the assembly is adapted for enhancement so that a ball catching net assembly and trough device can be added to the assembly if desired.

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Brief Description of the Drawings

Fig. 1 is a perspective view of the robot table tennis net and server assembly of the present invention mounted on a table to illustrate environment;

Fig. 2 is a perspective view of the robot table tennis net and server assembly of the present invention;

Fig. 3 is a perspective view of the robot table tennis net and server assembly of the present invention in a partial state of collapse;

Fig. 4 is a top plan of the robot table tennis net and server assembly of the present invention;

Fig. 5 is a side elevational view of the robot table tennis net and server assembly of the present invention;

Fig. 6 is a partial, top plan of the robot table tennis net and server assembly of the present invention illustrating ball dam function;

Fig. 7 is a partial top plan of the robot table tennis net and server assembly of the present invention illustrating the ball trough;

Fig. 8 is a perspective view of the robot table tennis net and server assembly of the present invention folded for carrying or storage;

Fig. 9 is a perspective view of the robot table tennis net and server assembly of the present invention folded for carrying or storage in an optional carrying case;

Fig. 10 is a partial, enlarged view of the net assembly illustrating the impenetrable net;

Fig. 11 is a partial, enlarged view of the forward net of the present invention illustrating a ball passing through the forward net;

Fig. 12 is a schematic illustrating the various dispositions of balls striking the net assembly of the present invention; and

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Fig. 13 is a perspective view of a ball dam component of the present invention.

Fig. 14 is an exploded view of the panning head and panning mount assembly of the present invention,

Fig. 15 is an exploded bottom plan view of the panning head and

Fig. 16 is a perspective view of another embodiment of the table tennis net and server assembly of the present invention.

Fig. 17 is a perspective view of an alternative embodiment robot server assembly of the present invention mounted on a table to show environment;

Fig. 18 is a perspective view of one preferred embodiment of the robot server assembly of the present invention;

Fig. 19 is a side elevational view of the embodiment of the robot server assembly of the present invention as shown in Fig. 18 which is mounted to a table shown in phantom;

Fig. 20 is a partial cross-sectional view of the robot server assembly as shown in Fig. 19;

Fig. 21 is a perspective view of an alternative preferred embodiment of the robot server of the present invention;

Fig. 22 is a side elevational view of the embodiment of the robot server assembly of the present invention as shown in Fig. 21 which is mounted to a table shown in phantom;

Fig. 23 is a partial cross-sectional view of the robot server assembly as shown in Fig. 22;

Fig. 24 is a partial perspective view of the manual panning assembly of the present invention;

Fig. 25 is a perspective view of the optional panning head of the present invention; and

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Fig. 26 is an exploded view of the removable panning head and panning mount assembly of the present invention.

Fig. 27 is an exploded, bottom plan of the optional panning head of the present invention.

Description of the Preferred Embodiment

Referring now to the drawings, reference numeral 1 indicates one illustrative embodiment of the robot ball serving assembly of the present invention which is shown as being attached to a table tennis table T to demonstrate environment.

In general, assembly 1 contains the robot server 3, a first net assembly 5, a forward net 7, and a remote control unit 9 connected to robot server 3 by wire 11. The remote control unit 9 is designed to mount on the end of table T opposite assembly 1 so as to be easily accessible to a player positioned at table T at the opposite end from assembly 1. Each of the particular elements of assembly 1 will be described in detail hereinafter.

Turning now to a more detailed description of the server assembly as best illustrated at Figs. 2-7, server assembly 1 contains a robot server 3 removably mounted within base container section 13. The description and operation and function of robot server 3 is described in aforementioned U.S. Patents Nos. 4,854,588 and 4,917,380, for example, such the descriptions and operative functions are herein incorporated by reference. Robot 3 is removably mounted within container 13 by appropriate means such as nut and bolt assemblies, for example, wing nut assemblies or the like (not shown).

Base container section 13 is of a generally rectangular configuration and is constructed to hold a plurality of table tennis balls. Container section 13 has a front vertical panel 15 and a rear vertical panel 17

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(Fig. 5). Vertical panel 17 has means (not shown) for supporting wing nut assemblies or other appropriate means in order to mount robot 3 to an inner surface of rear vertical panel 17. Container 13 has two end panels 20 and 23, respectively, (Figs. 5 and 7) which extend upwardly and are of a substantially lesser height than front panel 15 and rear panel 17 so as to accommodate the mounting of trough sections 19 and 21, as will be explained hereinafter.

As stated above, table tennis balls can be held in container 13 and can roll or flow into the open mouth section 4 of robot 3 so as to engage the internal working mechanism of robot 3 and thereby be expelled from robot 3, as described in my earlier patents. Since robot 3 is mounted on rear panel 17, mouth 4 faces the front of the assembly. In use, a pool of table tennis balls forms within container section 13 so as to provide a continuous source of balls to mouth 4 of robot 3. Furthermore, ball dams 25 and 25 can be slidably mounted in container section 13 so as to create a closed container (Fig. 6) to hold the pool of balls in one place when the assembly is collapsed for carrying or storage, as will also be explained hereinafter.

As stated above, base container 13 is cooperatively connected to troughs 19 and 21 (Figs. 5 and 7). In collapsed position, troughs 19 and 21 are positioned above side walls 20 and 23 and are hingedly connected, for example, at hinges 27 and 29 through cantilever arms 31, 33 and 35, 37, respectively (Figs. 6 through 9). This cantilever design allows troughs 19 and 21 to clear walls 20 and 23 and ball dams 25 when troughs 19 and 21 are folded upwardly for storage or carrying (Figs. 8 and 9). The bottom side edges of troughs 19 and 20 rest against the tops of walls 20 and 23 so that the troughs

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cooperatively engage container 13. Troughs 19 and 21 slope slightly toward container 13 so that balls falling into troughs 19 and 21 will flow toward the pool of balls formed in section 13. Table tennis balls fall into troughs 19 and 21 from net assembly 5, as will now be described.

Net assembly 5, as best illustrated in Figs. 2-5 is constructed of a table tennis ball impenetrable or, impassable net 41. Net 41 is a mesh-type net which may be constructed from many appropriate materials or fibers such as cotton, nylon or other materials. A plurality of openings or holes formed in net 41, as shown at 42, are of such dimensions as to be impenetrable to a table tennis ball striking net 41 at any velocity (see Fig. 10). Furthermore, the elasticity of net 41 should not be such as to allow holes 42 to spread upon the force of the striking table tennis ball, allowing the ball to pass through net 41. Net 41 has a solid edge 43 around the periphery to bind the netting in its desired shape (Fig. 2). Edge 43 can have small pockets (not shown) or other means located for example at 45, 45a, and 45b to engage or hold arms for supporting the net, as described below.

Net 41 is stretched across a plurality of arms. In the illustrative embodiment three such arms are employed to support net 41, the arms shown generally as at 47. The arms 47 are, in general, semi-flexible rods constructed in two separable sections as shown as 49a and 49b in Fig. 3. The two sections are connected by a suitable connector means 51 which can be constructed from a hard rubber block or the like with holes formed therein to accept the end-to-end alignment of sections 49a and 49b. Other suitable connector means such as a sleeve assembly may be used. Furthermore, the connector means 51 may contain channels or clips or other means for securing the two

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separated sections in a side-by-side relationship when the arms are disassembled, for folding or storage as shown in Fig. 3.

Arms 47 are pivotally mounted and radiate out from an arm securing means 59 which is affixed to external side of panel 17, as shown in Fig. 5. Arm securing means 59 allows lateral movement of the arms so that arms 47 can be pivoted or fanned out for use or can be folded upward for carrying or storage.

Net 41 is suitably attached above and along one side of troughs 19 and 21 by appropriate attachment means (not shown) so as to form a contiguous, ball impenetrable barrier around the ends and back edge of troughs 19 and 21, as well as around container section 13, thereby forming a contiguous net assembly around robot 3. As best shown in Fig. 5, net 41 is situated back from the front edge of container 13 so as to not impinge upon the playing surface, while completely surrounding the robot 3.

A second or forward net 53 (shown as 7 in Fig. 1) is suspended in front of net 41 to substantially enhance the ball trapping properties of net assembly 5. As noted in the background of the invention, in prior art assemblies employing a single net assembly, a table tennis ball may strike the net with sufficient force to carom away from the assembly and out of use.

Forward net 53 eliminates that disadvantage. Forward net 53 is constructed from a suitable material or fiber such as cotton or nylon and has solid edge 53 defining the shape thereof. A plurality of holes, as at 57, are formed therein and are formed in the appropriate size or dimension so as to allow a table tennis ball striking net 53 at a pre-determined velocity to pass through a particular hole 57. The dimensions of holes, 57 relative to a table tennis ball, is best illustrated at Fig. 9. It

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has been found in one preferred embodiment that an opening 57, of the dimensions 1 1/2 inches by 1 1/2 inches is optimum so as to allow a table tennis ball at a pre-determined velocity to pass through hole 57 of net 53 (Fig. 11) and strike net 41 (Fig. 10).

Net 53 is suspended from net 41 by appropriate hanging or suspension means as shown at 61 in Fig. 5. The top of net 53 is suspended below edge 43 of net 41 to create an opening or gap 63 between net 41 and forward net 53.

The spacial arrangement between rear net 41 and forward net 53 works most effectively to trap balls as best illustrated in Fig. 12. Forward net 53 is suspended in front of and slightly below net 41 creating gap 63 between the top of net 41 and the top of net 55. A ball, as at B1 returned to net assembly 5 by a player is captured and drops into trough 19 or 21 in a variety of ways as will now be explained.

First, as illustrated by arrow 65, a ball passing above forward net 53 through gap 63 will strike net 41 and drop directly into trough 21. Gap 63 is of such dimensions and is positioned relative to nets 41 and 53 so that a ball passing through gap 63 will strike net 41 at an angle that will cause ball B to drop into trough 21.

Arrow 67 illustrate a second possible disposition of a ball shot back at net assembly 5. As shown by arrow 67, ball B2 hit with sufficient velocity will pass through opening 57 (see Fig. 11) in net 53 but will lose velocity, strike net 41 and drop into trough 21.

Arrow 69 illustrates the disposition of ball B3 passing through net 53 with sufficient velocity so as to bounce off net 41 and strike the back side of net 53 and fall into trough 21. As illustrated by arrow 69, ball B loses sufficient velocity or kinetic energy by passing

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through net 53 and by striking net 41 that it lacks sufficient velocity to penetrate net 53 from the back side, thereby causing ball B₃ to bounce off the back side of net 53 and drop into trough 21.

Arrow 71 illustrates a final possible disposition of a ball struck back at net assembly 5. Holes 57 (Fig. 11) in net 53 are of such a pre-determined dimension as to allow the passing of a ball at sufficient velocity so as to penetrate net 53. Where, however, as illustrated by arrows 71, ball B₄ strikes at a velocity insufficient to penetrate the holes in net 53, the ball will simply drop into trough 21 in front of net 53. A ball striking net 53 with insufficient velocity to penetrate net 53 will lack the energy to bounce off net 53 out of play and will drop into trough 21.

Turning now to the continuous ball feeding aspects of the invention, as stated above, the net arrangement causes the ball, as returned toward net assembly 5 by the player, to drop into troughs 19 or 21 and roll toward the pool of balls contained in container 13. Robot 3 is positioned to the rear of container 13 so that mouth 4 faces forward to accept balls from the pool of balls. Troughs 19 and 21 are formed from a suitable light-weight, semi-rigid material such as plastic or fiberglass. The depth of the trough is greater near robot 3 so that the internal floor 19a and 21a of troughs 19 and 21 respectively (Fig. 4) slope downward toward container 13 to act as ramps for the balls to roll down. As described above, troughs 19 and 21 abut the top of side panels 20 and 23, respectively, forming a closed ball return configuration.

Assembly 1 is attached to table T by a suitable mounting means. In one illustrative embodiment, the mounting means is constructed with plate 72 having a top protruding member 73 with a friction member such as hard

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rubber (not shown) on the bottom side thereof designed to rest on top of table T, and two opposed, splayed, protruding bottom members, 75 and 76 extending well beyond the length of top member 73 and designed to brace against the bottom side of a table to allow the assembly to rest on the table secure under its own weight. The attachment assembly is designed to be a quick mount and quick release assembly. The assembly can be easily attached to the end of the table by sliding top member 73 and bottom legs 75, 76 onto the end of the table. The assembly can be quickly and easily removed by grasping the assembly, lifting slightly up and forward so that member 73 is spaced upwardly from the table top and then legs 75 and 75 are slipped from under the table. Plate 72 is attached to the exterior of panel 15 by hinge 77 to allow the attachment means to be pivoted up and out of the way for compact carrying or storage as will now explained. It should be noted, however, that there may be alternative configurations for the attaching means without departing from the scope of the present invention.

The assembly of the present invention is collapsible, as well as foldable for storage and carrying. Fig. 1 illustrates all components of the game, fully assembled for use on a table; Fig. 2 illustrates assembly 1 in detail; and Fig. 3 illustrates the assembly 1 in the first stage of collapse and folding. As noted above, ball dams 23 and 25 have been inserted so that the balls can be pooled in container 13 for storage.

In order to understand the collapsible features of the device, Fig. 3 demonstrates arm sections 49a and 49b disassembled and secured in side-by-side relationship by fastener 51 as previously explained. Rear net 41 and forward net 53 are collapsed. Plate 72 is folded up along hinge 77 so that bottom leg members 75 and 76 straddle

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robot 3 and are thus out of the way for storage and carrying.

Figs. 8 and 9 illustrate the assembly folded for carrying or storage. Troughs 19 and 21 assume a nearly vertical position with the nets, the arms, and robot server nested inside. Ball dams, as at 25, are in place to hold the balls within container 13. Although not shown in the drawings, remote control unit 9 (Fig. 1) can be stored within container 13 so that all components of the assembly are conveniently packed. A strap 79 can be fastened by velcro or a simple latch or other means from trough 19 to trough 21 to hold the folded assembly tightly in place. Fig. 9 illustrates folded assembly 1 inside an optional carrying case shown generally at 81. Case 81 can be made of any appropriate material, for example, molded plastic with two halves 84 and 86 and a hinge (not shown) and latch 85 to allow closing. Case 81 has a handle means 83 thereon for carrying.

A ball dam, as at 25, is illustrated in more detail at Fig. 13. Ball dams 23 and 25 are constructed of appropriate material, for example, high impact plastic. Ball dam 25 is generally a web structure having a general, peripheral configuration the same as the internal configuration of container 13 so that ball dam 23 can be slidably mounted into slots formed inside of container 13 and effectively close off container 13 as shown in Fig. 6. It should be noted that ball dams 23 and 25 can function to hold the balls outside of container 13 as well, that is, dams 23 and 25 can be used to retain the balls on the trough side of each dam so that robot 3 can be disengaged from container 13 while retaining the net assembly and troughs, with the balls contained therein, on the table. Each dam 23, as illustrated in Fig. 13, has a hole 24 formed in one end thereof. Hole 24 is the

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diameter of a table tennis ball in n ar perfect roundness. Hole 24 thus functions as go/no-go gauge for the sizing of table tennis ball for use in the assembly. Robot 3 functions most efficiently with table tennis balls of the appropriate size and near perfect roundness. Some commercially available table tennis balls are of low quality and can be of various diameters, mishappened, and out of round. In use, the player can attempt to pass a table tennis ball trough hole 24; if the ball fits through hole 24, the ball is of the proper size and roundness to work efficiently in robot 3; if the ball will not pass through hole 24, the ball is either too large or too mishappened to be used effectively within robot 3 and the ball should be discarded. This unique feature improves the game in that it prevents time consuming jamming of robot 3 as well as damage to robot 3 by mishappened or incorrectly sized balls.

Figs. 14 and 15 illustrate the panning head assembly of the present invention. The automatic panning head assembly of the present invention. The automatic panning head is shown generally at 91. Panning head 91 contains plug contacts 93 and 94 and can be operated by a player through remote unit 9 (Fig. 2). Plug contacts 93 and 94 are inserted into receptacle holes 99 and 101 to complete electrical contact with control box 9. Panning head 91 can be controlled by the player so that it automatically moves levers 83 and 85 to change the side-to-side position of ball expeller 10 (Fig. 1). Fig. 15 illustrates the working mechanism of panning head 91. When panning head 91 is connected to the server, gear 102 engages levers 83 and 85 while rotating so as to move the levers and the connected ball expeller 10 back-and-forth. Guard 87 extending up from lever base 89 is designed to prevent lever grips 84 and 85 from becoming entangled in the netting.

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Fig. 16 illustrates another embodiment of the robot table tennis net and server of the present invention shown generally at 1'. The assembly 1' contains the robot server 3', having a ball expeller 10', a first net assembly 5', a forward net 7', and pair of side wing nets 8' to prevent balls from escaping over the side edge of table T, and a remote control unit 9' connected to robot server 3' by wire 11.

Side wing nets 8' are suspended from curved, rigid rod 47' which extend down the side of table T to the middle of table T. As stated above, this unique configuration prevents balls hit back toward robot 3' from rolling off or leaving the edge of table T.

Fig. 17 illustrates an alternative embodiment of the robot server assembly of the present invention, shown generally at 200, which is mounted on a table tennis table T to demonstrate environment. The assembly contains a tray 203 designed to hold a plurality of table tennis balls. Tray 203 is removably attached to table T by a mounting assembly shown generally at 205. Robot server 207 is mounted to the tray, the function and operation of robot 207 being described in my U.S. Patent Nos. 4,854,588 and 4,917,380, for example, which are hereby incorporated by reference.

The assembly employs a remote control unit 209 placed at the opposite end of the table from the robot assembly so as to be easily accessible to the player. Unit 209 is operatively connected to robot 207 by wire 211 and functions to control the operations of robot 207 as well as the optional, removable panning device, as will be described hereinafter such panning device has also been described in detail in the aforementioned patents incorporated herein by reference.

A more detailed description of each of the individual components of assembly 1 will now follow.

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Figs. 18-20 illustrate one preferred embodiment of the present invention shown generally at 201a. The assembly contains a robot 207a having a mounting assembly shown generally at 205 attached to robot 207a for mounting the assembly to a table. Assembly 205 is a quick release mounting mechanism containing a lower plate 213 hingedly connected to upper plate 215 by hinge 216 so that assembly 205 can be pivoted up and out of the way for storage or carrying as shown in Fig. 18. Plate 213 is suitably attached to a first stabilizer bar 217 by attachment means (not shown) such as screws or bolts. First stabilizer bar 217 is attached to second stabilizer bar 219 by nut and bolt assemblies 221 and 223 through slots 225 and 227, respectively. Bolt assemblies 221 and 223 can be loosened or removed so that bar 217 can be removed from bar 219. Bar 219 can then be mounted directly to the end of the table by using proper screws or bolts, thereby eliminating the quick release mounting assembly 205, if desired.

Assembly 205 contains lower, splayed brace arms 229 and 231 and top brace member 233. As illustrated in Figs. 19 and 20, splayed arms 229 and 231 extend outwardly from plate 215 well beyond the length of top brace 233. Top brace 233 rests on the top of the table while arms 229 and 231 are formed in a wide U-shape so that the tip of each arm, as shown at 235, will reach out and abut the bottom of table T. The assembly rests on table T secured under its own weight. The entire robot server assembly can be quickly removed from table T by grasping the assembly and tilting it slightly upward and forward, lifting member 233 from table T and then sliding arms 229 and 231 free from under table T.

Turning now to the ball container component of the embodiment as shown in Figs. 18-20, assembly 201a contains a tray 237, (shown as 203 in Fig. 17). Tray 237 is of a

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generally rectangular shape having vertical side walls as at 241, a lower pan 243 formed as a bottom, as well as front and rear vertical walls 245 and 247. Tray 237 is constructed from a suitable material, such as high impact plastic or the like, and is attached to robot 207 through front wall 245 by screws 249 and 251 or other appropriate attachment means. It should be noted that tray 237 can be constructed in any convenient or functional configuration and of such dimensions that will allow it to house the lower portion of robot 207 along with a plurality of table tennis balls (not shown).

As shown in Fig. 20, tray 237 is mounted to the lower portion of robot 207. Robot 207 has a receiving means or opening 208a that is designed to receive table tennis balls from the plurality of balls placed in tray 237. The balls are fed up through robot 207 and expelled through expelling means 210a onto the playing surface of table T. The bottom of pan 243 slopes gently to opening 208a so that balls will roll into opening 8a and provide a supply of balls to be expelled from the device. It should also be noted that tray 237 can be removed by loosening attachment means 249 and 251 so that tray 237 can be replaced by a more elaborate container capture net, and trough assembly (not shown) that is designed to catch the balls hit back at the robot and feed them to receiving means 8a.

Figs. 21-23 illustrate another preferred embodiment of the robot server assembly of the present invention shown generally at 201b. Assembly 201b contains a robot 207b constructed so as to have a ball receiving means 208b facing forward toward table T (Fig. 7) as will be explained hereinafter.

In this embodiment, assembly 1b has mounting means 205, containing plates 213 and 215, hinge 216, table

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supporting arms 229 and 231, as well as top member 233 which function relative to table T just as previously described in reference to mounting means 205 employed on the assembly 201a. However, in assembly 201b, the quick release mounting means is attached directly to the ball container, as will now be explained.

Plate 213 is attached to mounting bar 253 by suitable attaching means such as screws or bolts (not shown) through slots 255 and 257. Slots 255 and 257 function analogously to slots 225 and 227 in assembly 201a so as to allow removal of mounting means 205 if the user desires to bolt the assembly directly to a table. Mounting bar 253 is secured to a second mounting bar 59 attached to front wall 267 of tray 261 (shown as 203 in Fig. 17). Tray 261 is generally rectangular in shape having vertical side walls 263 and 265 a vertical front walls 267, and a vertical rear wall 269. A bottom wall or pan 271 is formed as the bottom of tray 261 and is designed to house ball receiving means 208b of robot server 207b, as well as a plurality of balls. Pan 271 slopes toward ball receiving means 208b so that balls can roll into receiving means 208b to be expelled onto the table through expelling means 210b. It should be noted at this point that tray 261 can be formed of any appropriate material such as high impact plastic or the like and can be of variable dimensions and configurations to accommodate robot 207 and a plurality of balls as may be desired.

Robot server 207b is attached to back or rear wall 269 with appropriate means such as screw 273. Robot server 207b is further stabilized by securing rod 275 which extends from bracket assembly 277 in a broad U-shape under pan 271 up to plate 213. Securing rod 275 functions to keep the assembly in the proper position relative to table T and to prevent the tray and robot portions of the

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assembly from sagging or bending below the plane of table T.

Mounting bracket 277 is attached to a first bracket brace 279 which is removably attached as at 280 to second bracket brace 281 so that the entire assembly of brace 279, bracket 277, rod 275, as well as the components of mounting assembly 205, can be removed, if so desired. This enables the assembly to be modified by the addition of an optional capture net assembly (not shown), as in my aforementioned copending patent application.

In use, both robot server assembly 201a and 201b receive balls from the bottom through receiving means 208a and 208b, respectively, and then expel the balls from the top through expelling means 210a and 210b respectively. The side-to-side trajectory of a ball expelled from the expelling means is changed by aiming the expelling means at different sites on the playing surface. Fig. 24 best illustrates the aiming mechanism employed on both illustrative embodiments of the present invention.

Lever 283, which is cooperatively connected to expelling means 210a or 210b can be grasped by the player by placing a thumb and forefinger against wings 284 and 285. By shifting lever 283 back and forth, the player can position side-to-side or panning movement of expelling means 210a or 210b. Set screw 286 is loosened to permit lever 283 to be shifted back and forth along groove 288. When the desired position is reached, the user tightens set screw 86 against the edges of groove 288 to hold lever 283 and the expelling means in position. Lever guard 287 extending vertically up from lever gauge surface 289 is designed to prevent lever wings 284 and 285 from becoming entangled in a capture net (not shown) when the optional capture net is mounted on the assembly, as previously explained. Lever gauge surface 289 can have a gauge decal

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illustrating the movement of lever 283 and thereby the degree of lateral movement of expelling means 210a or 210b.

Fig. 25-27 illustrates an optional, automatic panning head shown generally at 291. Panning head 291 contains plug contacts 293 and 294 and can be operated by a player through remote unit 209 (Fig. 17). Cover plate screws 295 (Fig. 24) can be removed and allowing cover plate 297 to be removed so that control levers 290, 290a and panning head 291 can be attached as shown in Fig. 26. Plug contacts 293 and 294 are inserted into receptacle holes 299 and 301 to complete the electrical contact with control box 209 (Fig. 17). Panning head 291 can be controlled by the player so that it automatically moves lever 283 to change the side-to-side position of the ball expeller.

Fig. 27 illustrates the working mechanism of panning head 291. When head 291 is attached and electrically connected as described above, gear 292 is positioned between levers 290 and 290a. As gear 292 rotates, it alternately engages levers 290 and 290a so as to move the levers back and forth and thus automatically pan the ball expelling means.

Numerous variations, within the scope of the appended claims, will be apparent to those skilled in the art in light of the foregoing description and accompanying drawings.

For example, I envision that robot assembly 201a or 201b can be sold in the series of steps, which will reduce its initial low cost. The design and aesthetic appearance of robot assemblies 201a and 201b may also be varied. For example, the size, configuration, and construction of the ball container trays can be varied without departing from the scope of the invention. Furthermore, the

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configuration and construction of the quick release attachment means can be varied without departing from the scope of the invention. The various described descriptions and illustrations are merely illustrative and not to be interpreted in a limiting sense.

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WHAT IS CLAIMED IS:

1. In a robot serving assembly including a first net suspended above and along one side of a trough for catching balls dropping from the first net and for feeding the balls to a robot server positioned in front of the first net and operatively associated with the trough, the improvement comprising:

a second net, said second net suspended in front of said first net above and along a second side of said trough, said second net being constructed to allow table tennis balls to pass through said second net from the front but preventing table tennis balls from passing back through the second net from the rear, thereby trapping said balls between said first and second nets and allowing said trapped balls to drop into said trough.

2. The improvement of claim 1 wherein the second net is suspended and supported by the first net.

3. The improvement of claim 2 wherein an upper edge of the second net is spaced from the first net to provide an upper opening between said nets for directly receiving table tennis balls.

4. The improvement of claim 3 wherein a lower edge of the second net is spaced upwardly a short distance from one side of said trough to allow table tennis balls with insufficient velocity hitting the second net to fall directly into the trough.

5. The improvement of claim 4 wherein the second net has an opening for receiving part of the robot server from which balls are ejected in a predetermined manner.

6. The improvement of claim 5 wherein said second net is removable relative to said first net.

7. The improvement of Claim 1 further comprising:
a pair of side wing nets extending from said first net to a point midway the length of a table tennis table,

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each said side wings constructed to prevent a table tennis ball from leaving said table along the edge of the table.

8. In a robot serving assembly including a trough for feeding balls to a robot server, said trough being foldable with said assembly for storage the improvement comprising:

a pair of ball dams, said ball dams being constructed so as to be removably mountable within said trough, each said ball dam being mountable on opposite sides of said robot server for creating a pool of balls surrounding said robot so that the table tennis balls remain within said trough around said robot server when the assembly is folded up for carrying or storage to keep balls away from sensor if so desired.

9. The improvement of claim 7 wherein each said ball dam has a hole formed therein, each hole being formed to the exact diameter and shape of a table tennis ball, said hole serving as a go/no-go round ball gauge whereby the user can pass a table tennis through said hole to determine if the ball is shaped in a rounded or out-of-round condition.

10 In a robot serving assembly having a robot server and a mechanism for supplying table tennis balls to the robot server the improvement comprising:

tray means for a plurality of table tennis balls;

a robot server removably mounted within said tray means so as to receive said table tennis balls and expel said table tennis balls; and

attachment means hingedly attached to a front side of said assembly so as to attach said tray to a table tennis table.

11. The improvement of claim 10 wherein said attachment means is a quick release attachment means.

12. The improvement of claim 11 wherein said robot server is mounted to a back wall of said tray.

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13. The improvement of claim 10 wherein said robot server is mounted to a front wall of said tray.

14. The improvement of claim 12 wherein said robot server is disposed to receive table tennis balls through a lower front portion of said robot.

15. The improvement of claim 13 wherein said robot server is disposed to receive table tennis balls through a low rear portion of said server.

16. The improvement of claim 10 wherein said robot has detachable panning head means.

17. The improvement of claim 16 wherein said tray can be removed and a net and trough assembly for capturing said balls and returning them to said robot can be mounted to said robot in place of said tray.

AMENDED CLAIMS

[received by the International Bureau
on 22 February 1994 (22.02.94);

original claims 1-17 replaced by amended claims 1-18 (6 pages)]

1. In a ball serving assembly including a first net suspended above and along a first side of a trough for catching balls dropping from the first net and for feeding the balls to a robot server positioned in front of the first net and operatively associated with the trough, the improvement comprising:

a second net, said second net suspended in front of said first net above and along a second side of said trough with a lower edge of the second net spaced upwardly a short distance from said second side of said trough to allow table tennis balls with insufficient velocity hitting the second net to fall directly into the trough, said second net being constructed to allow table tennis ball having sufficient velocity to pass through said second net from the front but preventing table tennis balls from passing back through the second net from the rear, thereby trapping said balls between said first and second nets and allowing said trapped balls to drop into said trough.

2. The improvement of claim 1 wherein the second net is suspended from and supported by the first net.

3. The improvement of claim 2 wherein an upper edge of the second net having a top edge spaced slightly below an upper edge of the first net creating a space slightly wider than a table tennis ball, whereby a tennis ball can pass over said top edge of said second net and impact said first net to thereby subsequently fall between said first and second nets before falling into said tray.

4. The improvement of claim 1 wherein the second net has an opening for receiving part of a robot server from which balls are ejected in a predetermined manner.

5. The improvement of claim 1 wherein said second net is removable relative to said first net.

6. A ball serving assembly for serving light-weight balls comprising:

a base section;

a robot server for serving light-weight balls mounted in said base section;

a trough assembly cooperatively connected to said base section;

a first net assembly attached to said base section and extending laterally outwardly therefrom on opposite sides thereof in order to surround said base section and said robot so as to stop balls hit back at said net assembly by a player, said net assembly extending above said trough assembly to enable balls stopped by said net assembly to fall into said trough assembly; and

a second net, said second net suspended in front of said first net and above said trough assembly, said second net being constructed so that a ball traveling at a predetermined velocity will pass through said second net and be captured between said first and said second nets, said second net having a lower edge spaced above the trough assembly to enable balls traveling at a predetermined velocity to strike said second net and drop directly into said trough assembly, said second net having a top edge suspended slightly below a top edge of said first net creating a space between said first net and said second net, whereby a ball can pass over said top edge of said second net and impact said first net and thereby subsequently fall between said first and second nets before falling into said trough assembly.

7. In a ball serving assembly, including a first net suspended above and along one side of a trough, a robot server mounted to said trough in front of said first net, said trough being constructed to feed balls to said robot, the improvement comprising:

a second net, said second net suspended in front of said first net, a top edge of said second net suspended slightly below a top edge on said first net to allow passage of a table tennis ball over said top edge of said second net and to impact against said first net and subsequently fall between said edges of said nets and to be trapped between said nets, said second net further having openings of sufficient dimension to allow said table tennis ball traveling at a pre-determined velocity to pass through the openings in said second net and thereby strike said first net, said table tennis balls upon striking said second net losing sufficient velocity so that said table tennis balls cannot pass back through the openings in said second net, thereby causing said table tennis ball to drop between said first net and said second net into said trough.

8. In a ball serving assembly mounted on a table tennis table including a first net having front and rear sides suspended above and along one side of a trough for catching balls dropping from the first net and for feeding balls to a robot server positioned on a front side of the first net and operatively associated with the trough, and said second net positioned on the front side of said first net, said second net having openings of sufficient size to allow a table tennis ball traveling at a sufficient velocity to pass through said openings and thereafter strike said first net to thereby cause the balls to be

captured between said first and second nets and consequently fall into said trough; the improvement comprising:

a pair of side wing nets extending from said first net to a point midway the length of the table tennis table, each said side wing nets constructed to prevent a table tennis ball from leaving said table along the edge of the table.

9. A ball serving assembly in combination with a table tennis table for serving light-weight balls comprising:

a base section;

a robot server for serving light-weight balls mounted in said base section;

a trough assembly cooperatively connected to said base section;

a first net attached to said base section and extending laterally therefrom on opposite sides thereof in order to surround said base section and said robot so as to stop balls hit back at said net by a player, said net extending above said trough assembly to enable balls stopped by said net to fall into said trough assembly;

a second net spaced from said first net and positioned inbetween said first net whereby balls may be trapped between said first net and said second net, a top edge of said second net being positioned slightly below a top edge of said first net whereby a table tennis ball can pass over said top edge of said second net and impact said first net and thereby subsequently fall between said first and second nets and thus into said trough assembly, said second net having openings therein so that a table tennis ball traveling at a predetermined velocity will pass

through said second net and be captured between said first and second nets, said second net having a lower edge spaced directly above the trough assembly to enable balls traveling at a predetermined velocity to strike said second net and drop directly into said trough assembly; and

a pair of side nets extending out from said trough assembly and said net assembly, each said side nets extending from said first net along an edge of the table tennis table assembly to a midpoint on said table tennis table to prevent a table tennis ball from leaving said table at said edge.

10. A robot server assembly mounted to a table tennis table for collecting and serving table tennis balls to a user comprising:

a self-supporting tray having a bottom wall and peripherally connected side walls integral to and extending upwardly from the bottom wall for collecting a plurality of table tennis balls;

a table tennis ball robot server removably mounted to said self-supporting tray, said robot server having lower table tennis ball receiving means positioned within said tray and located in proximity to the bottom wall of said tray for receiving table tennis balls collected within said tray; and

mounting means for removably mounting said tray and robot server to one end of a table tennis table, said mounting means being supported at least in part to and extending outwardly from said robot server, and said mounting means being collapsible for juxtaposition adjacent said robot server to facilitate carrying and storage of said robot server assembly.

11. The robot server as defined in Claim 10 wherein said self-supporting tray has a front wall adjacent said table tennis table and a rear wall opposed to and spaced from said front wall, said table tennis ball robot server being removably mounted to said rear wall.

12. The robot server as defined in Claim 10 wherein said self-supporting tray has a front wall adjacent said table tennis table and a rear wall opposed to and spaced from said front wall, said table tennis ball robot server being removably mounted to said front wall.

13. The robot server as defined in Claim 10 wherein said mounting means is also hingedly attached to said tray.

14. The robot server as defined in Claim 13 wherein said tray includes a front wall adjacent said table tennis table and a rear wall opposed to and spaced from said front wall and said mounting means is hingedly attached to said front wall.

15. The robot server as defined in Claim 14 wherein said tray includes a front wall adjacent said table tennis table and a rear wall opposed to and spaced from said front wall and said mounting means is hingedly attached to said rear wall.

16. The robot server as defined in Claim 10 wherein said tray can be removed and a net and trough assembly mounted to said robot server.

17. The robot server as defined in Claim 16 wherein said robot server has detachable panning head means for replacing a manual panning head with an automatic panning head.

18. The robot server as defined in Claim 17 wherein said mounting means includes quick release mounting means to facilitate mounting and removal from said table tennis table.

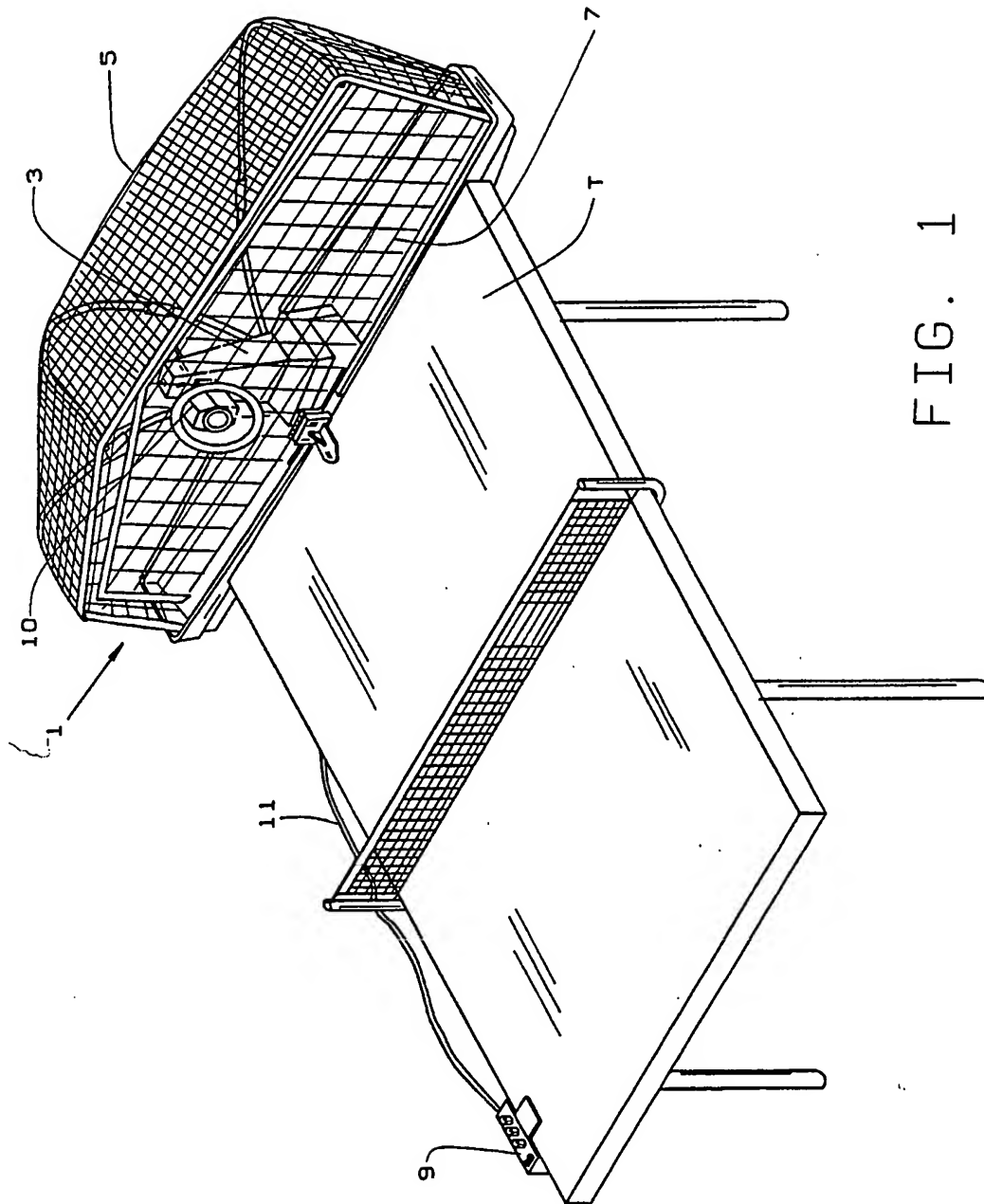
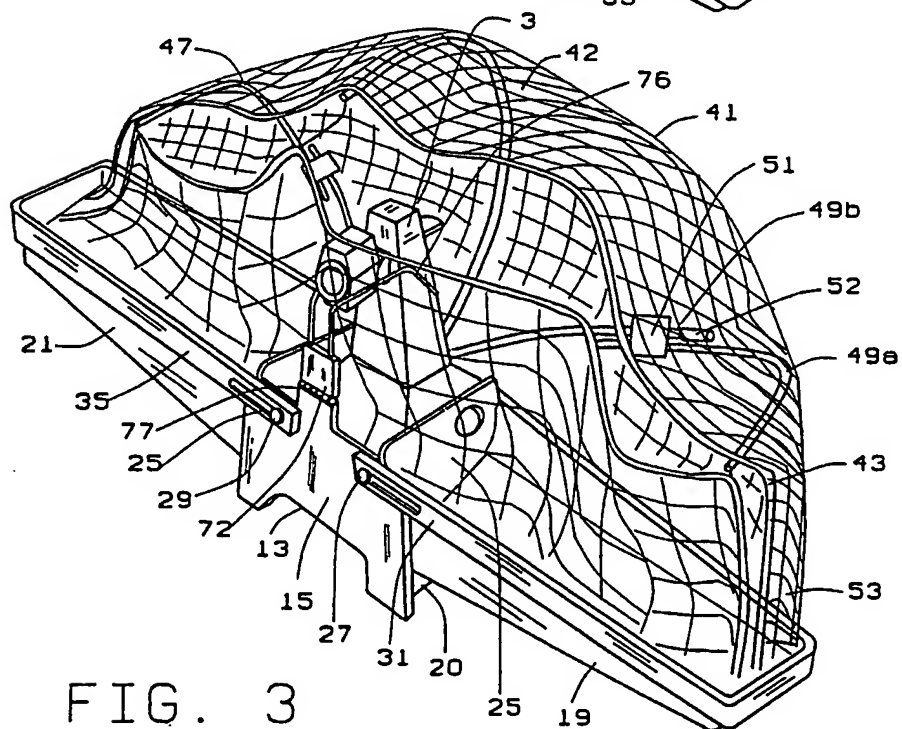
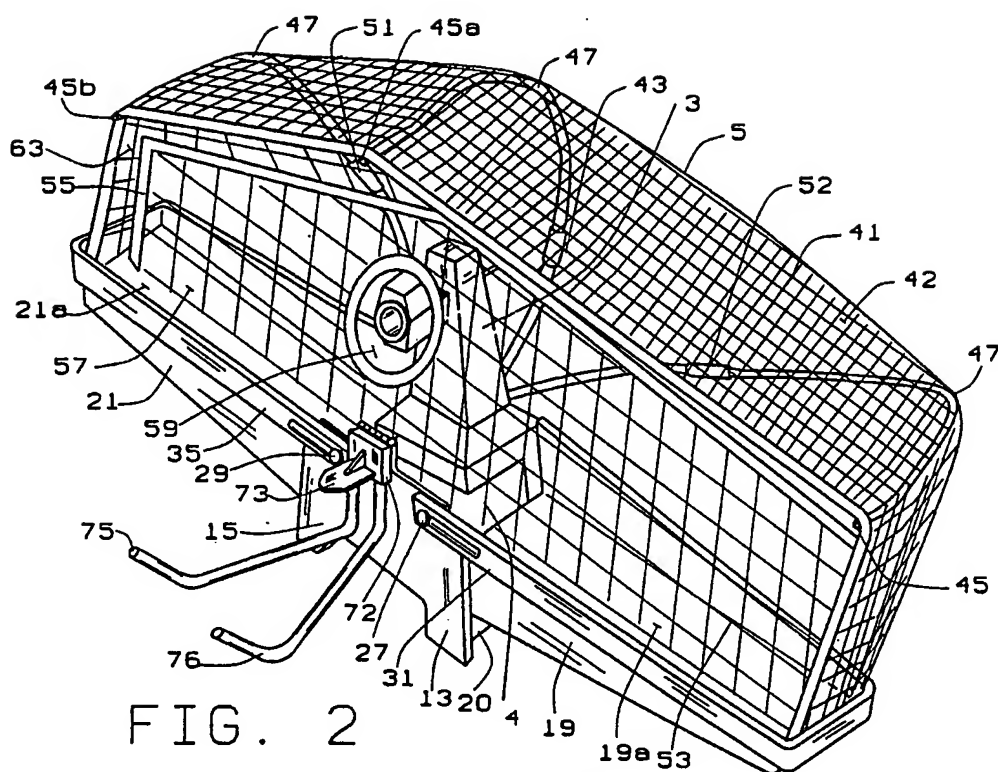
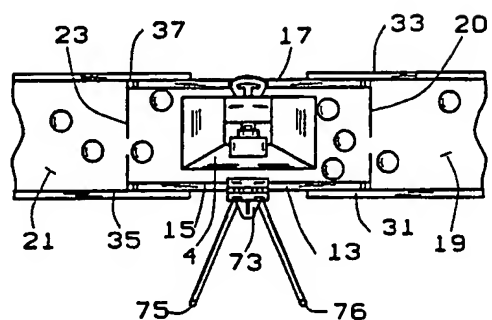
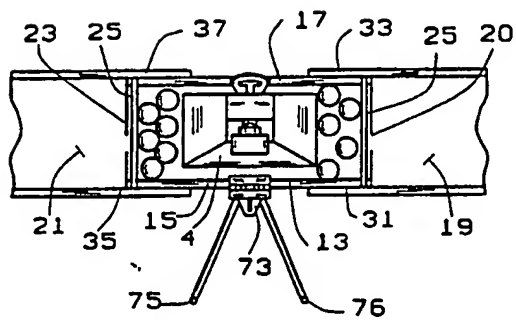
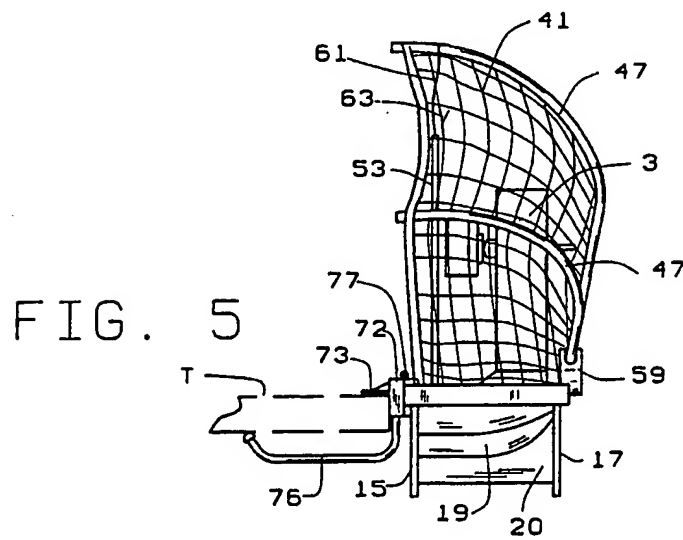
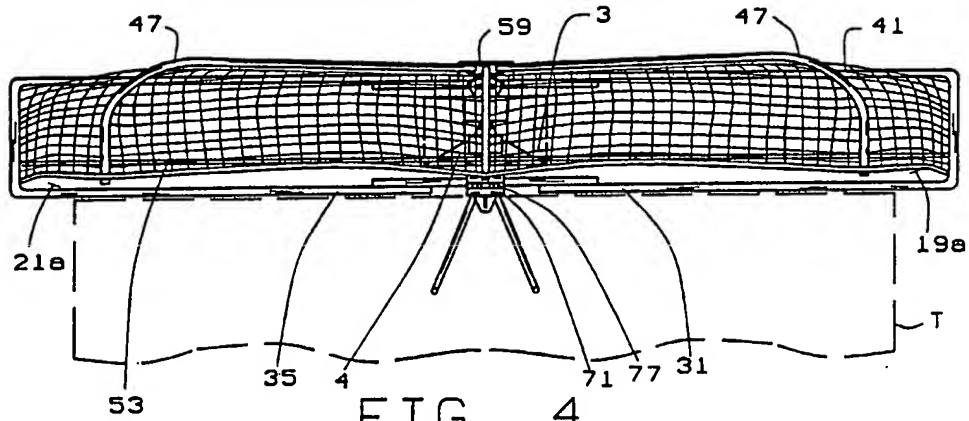


FIG. 1





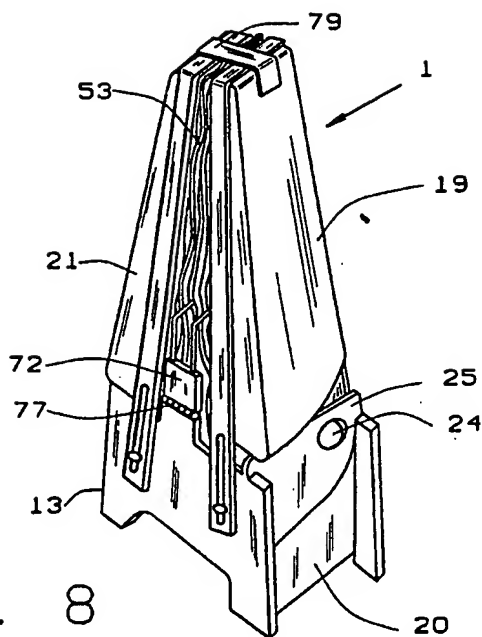


FIG. 8

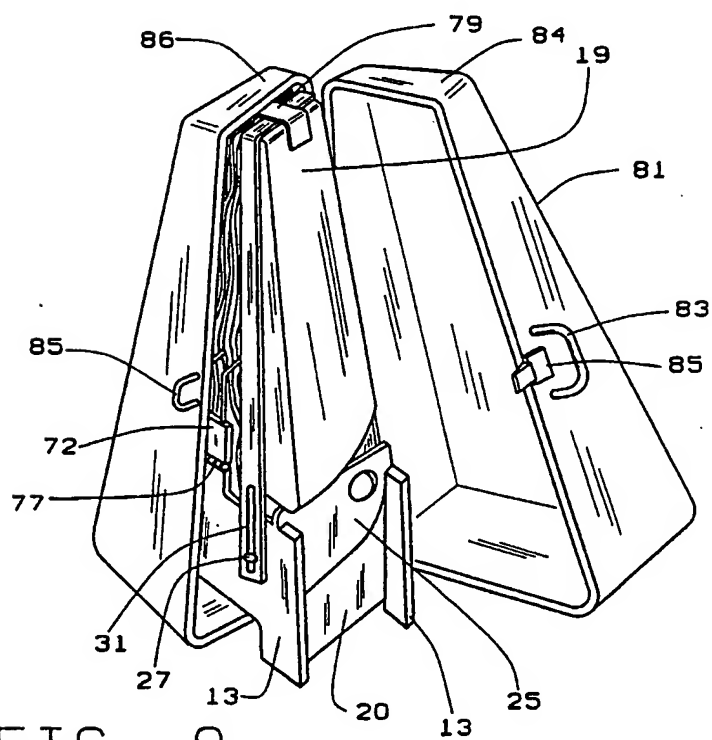


FIG. 9

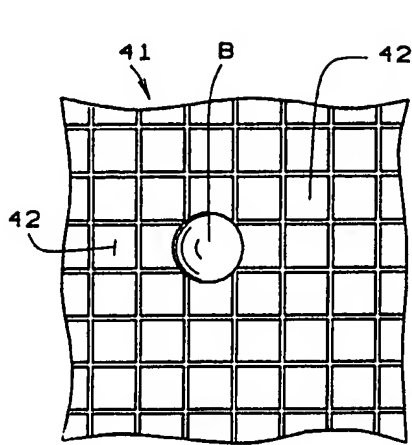


FIG. 10

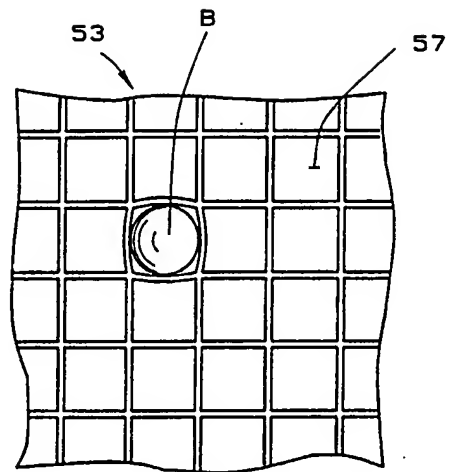


FIG. 11

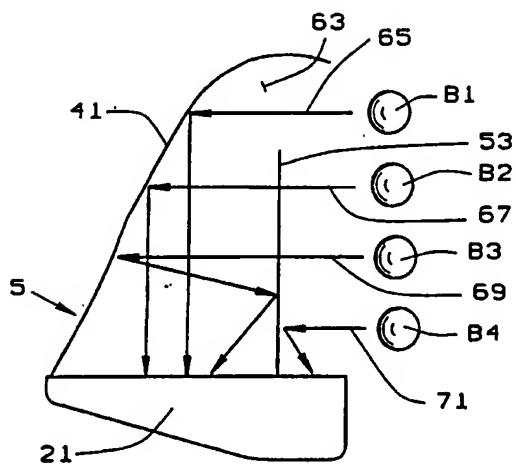


FIG. 12

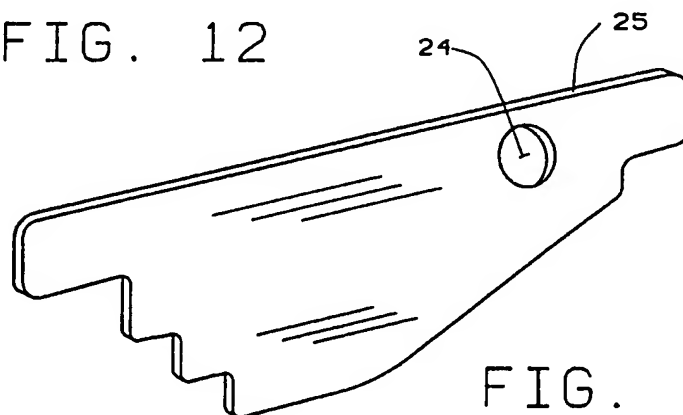


FIG. 13

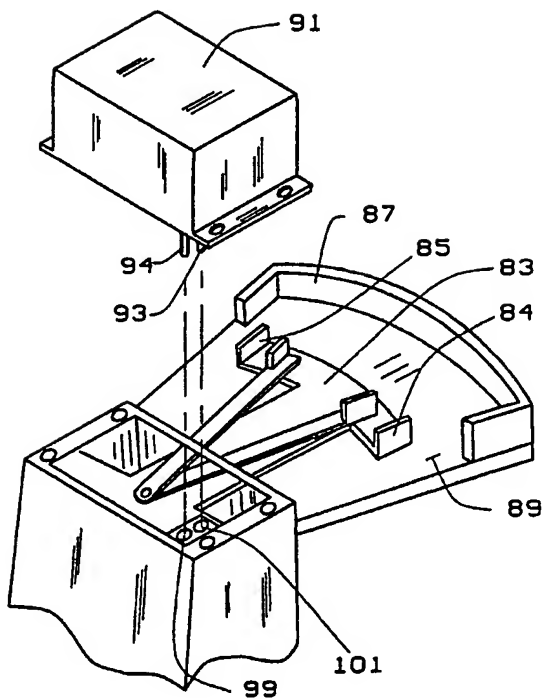


FIG. 14

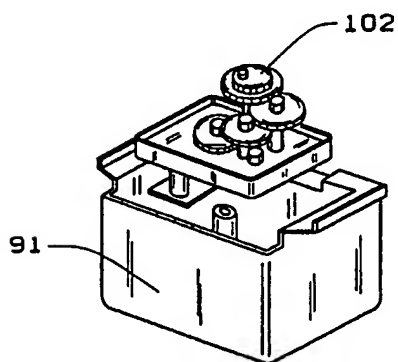


FIG. 15

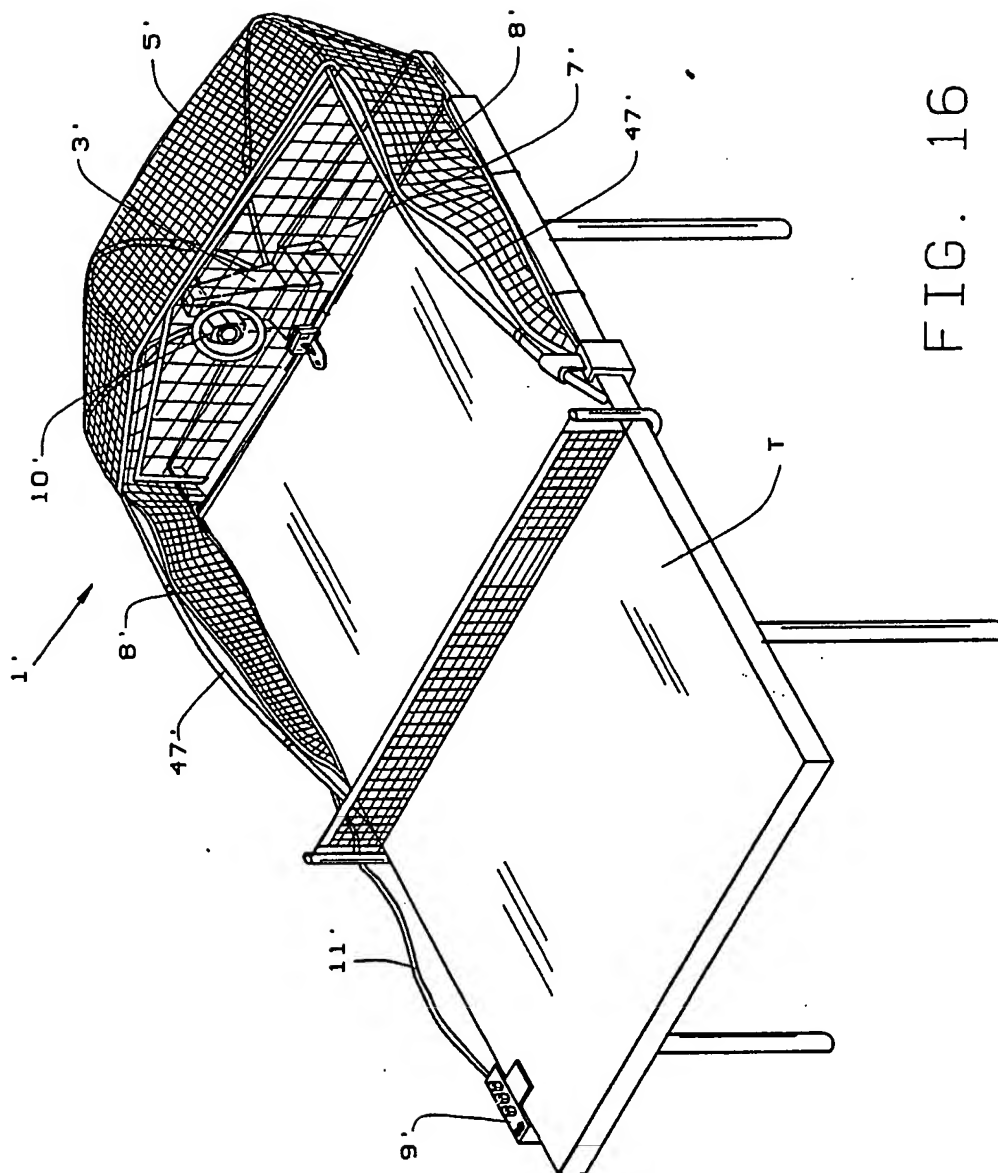


FIG. 16

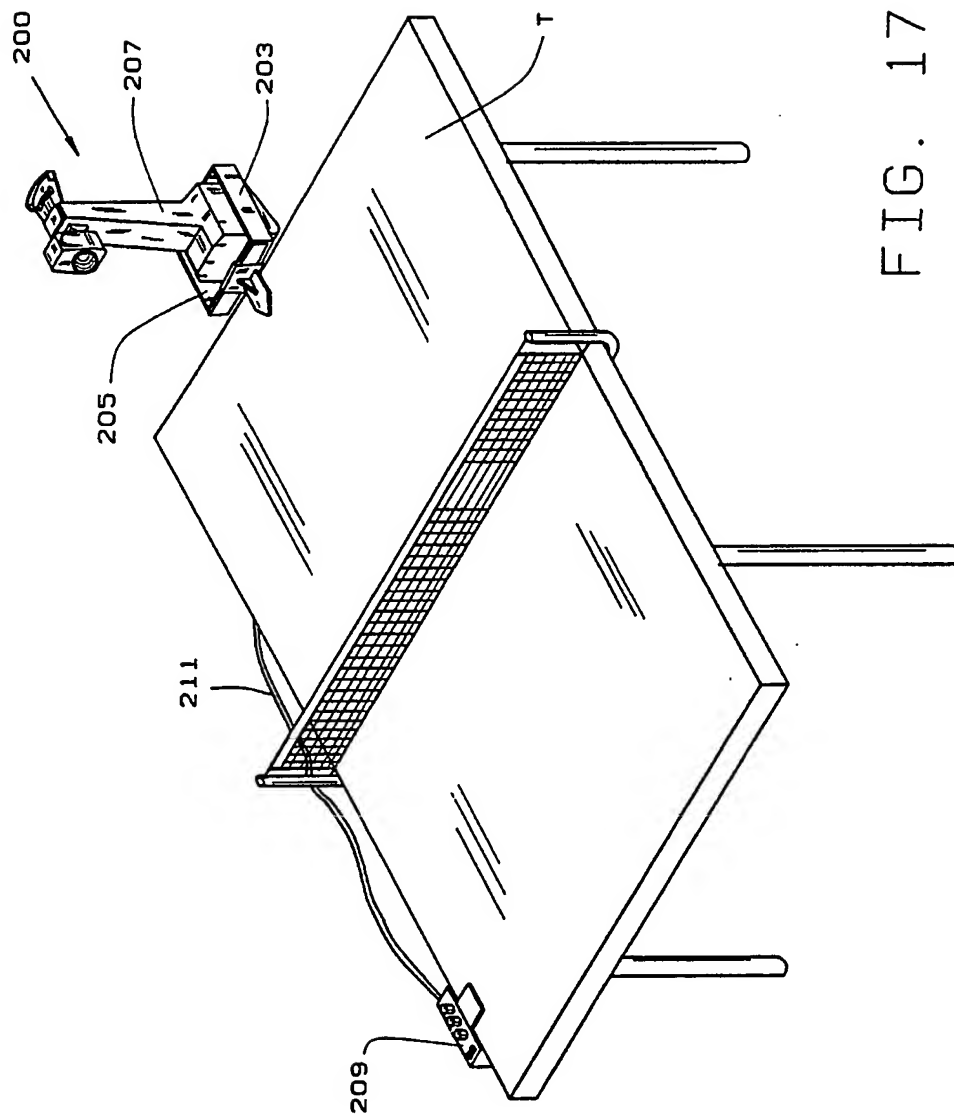
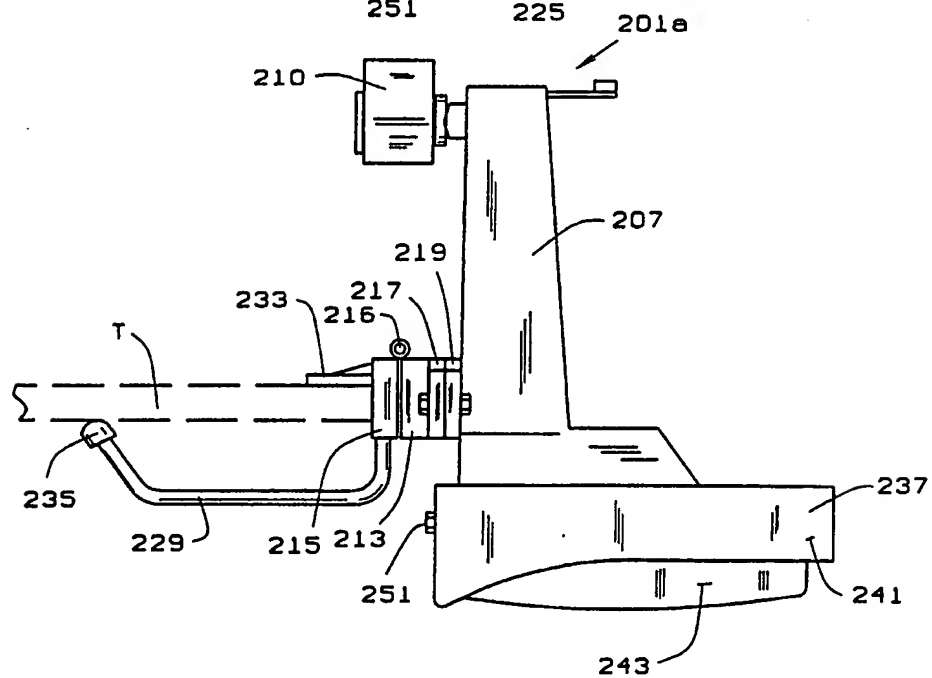
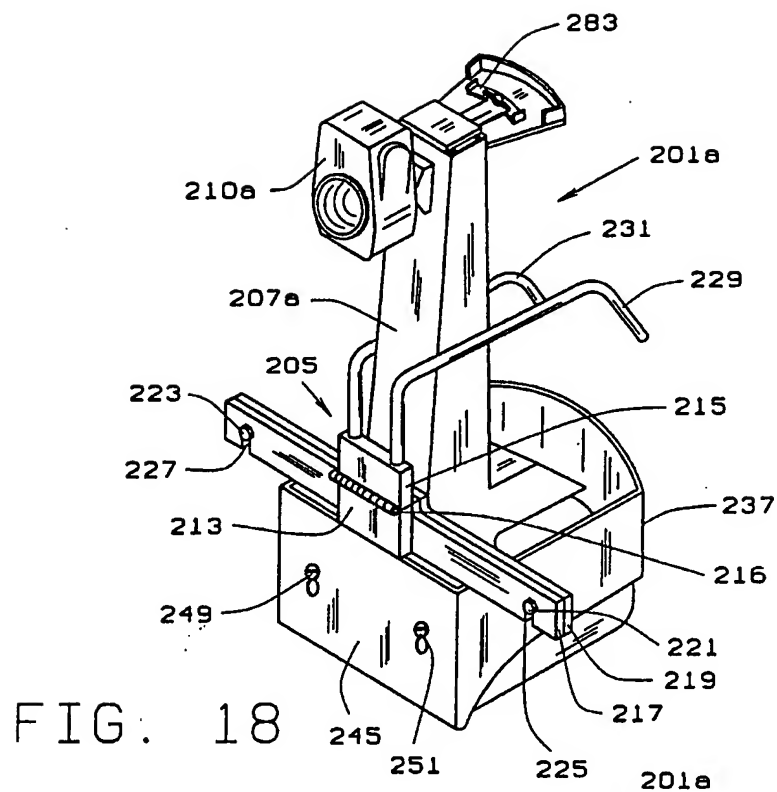


FIG. 17



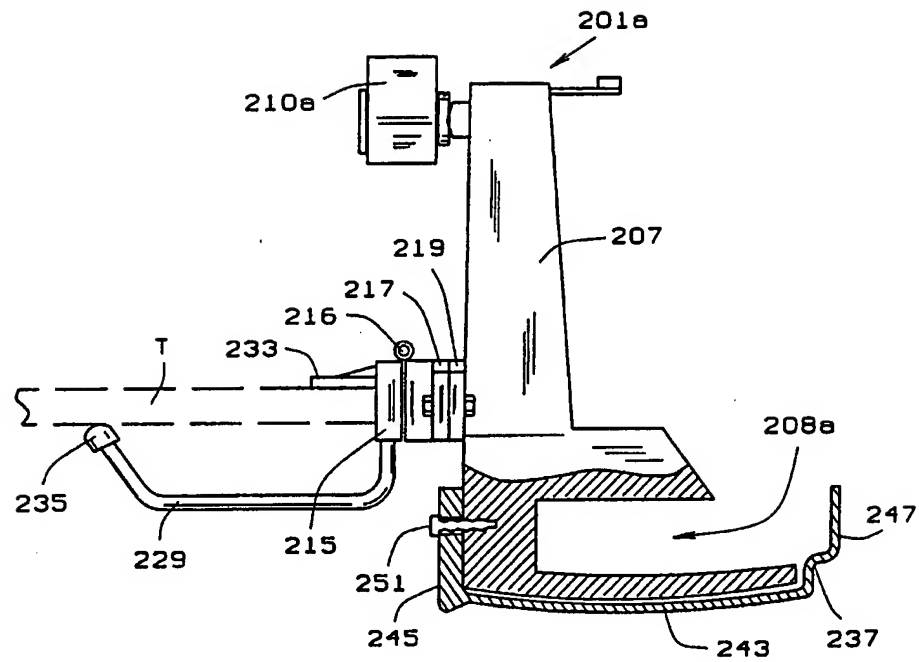


FIG. 20

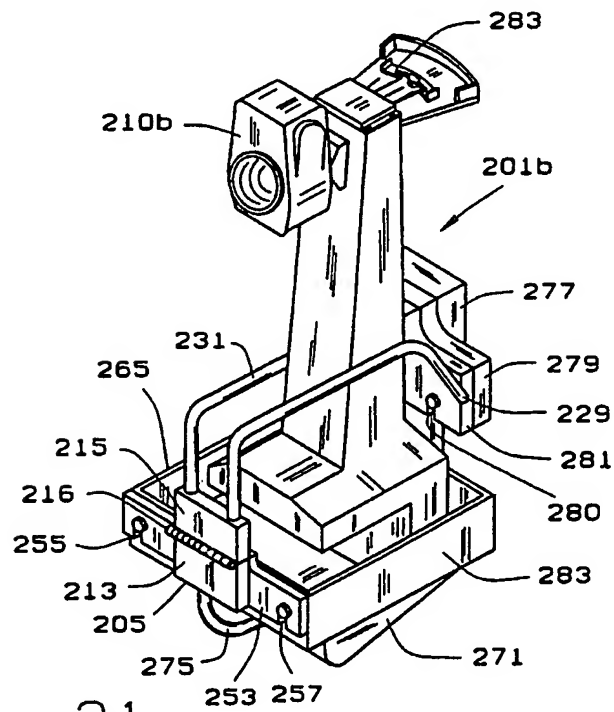
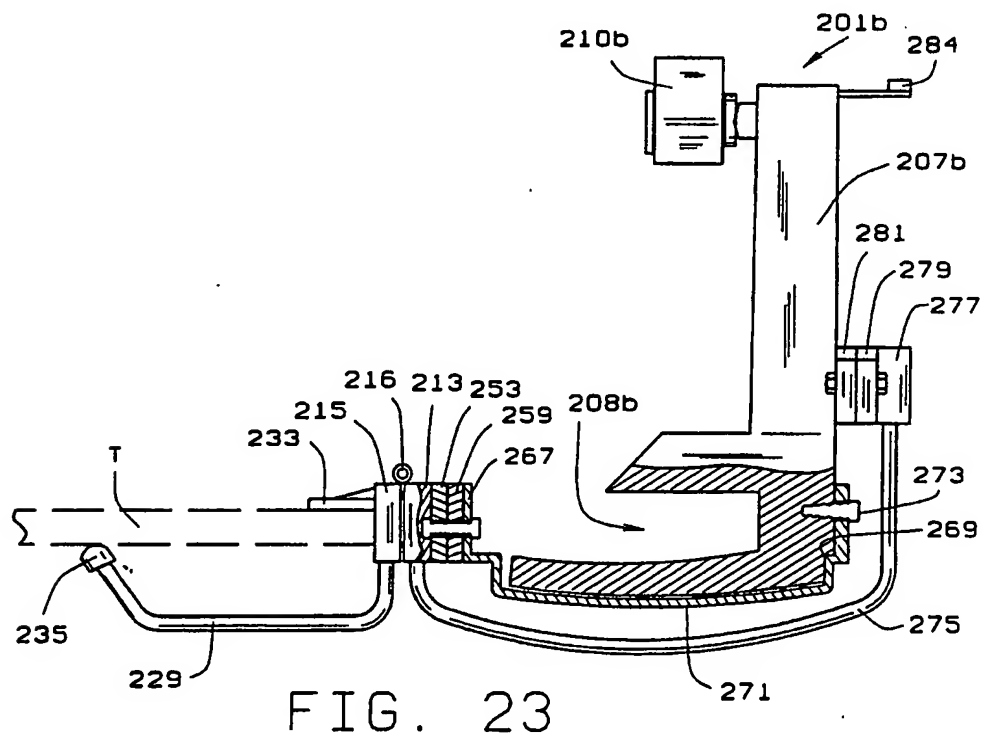
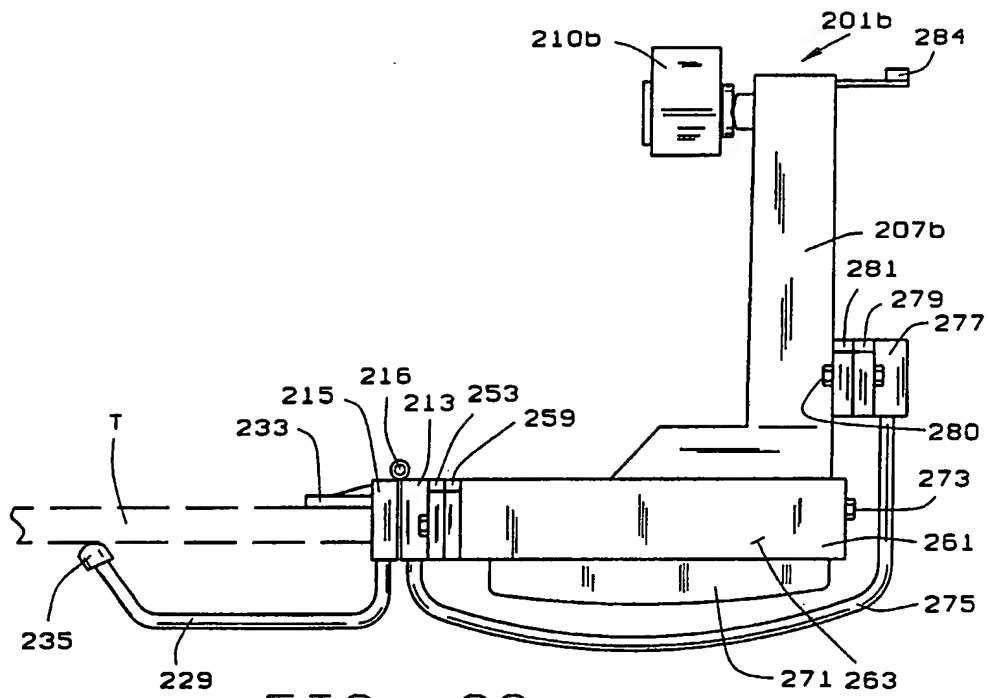


FIG. 21



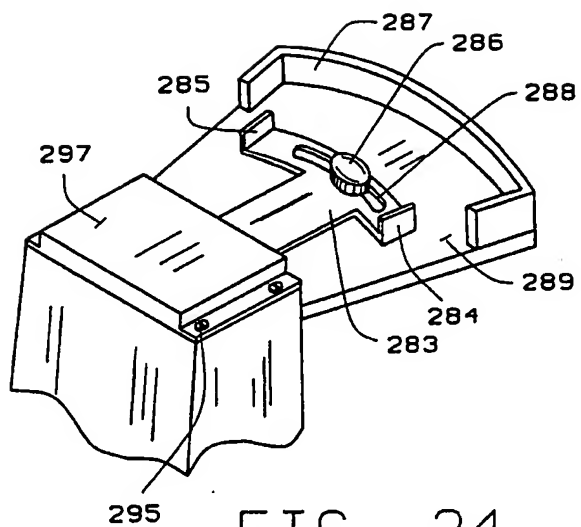


FIG. 24

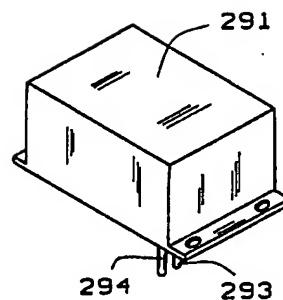


FIG. 25

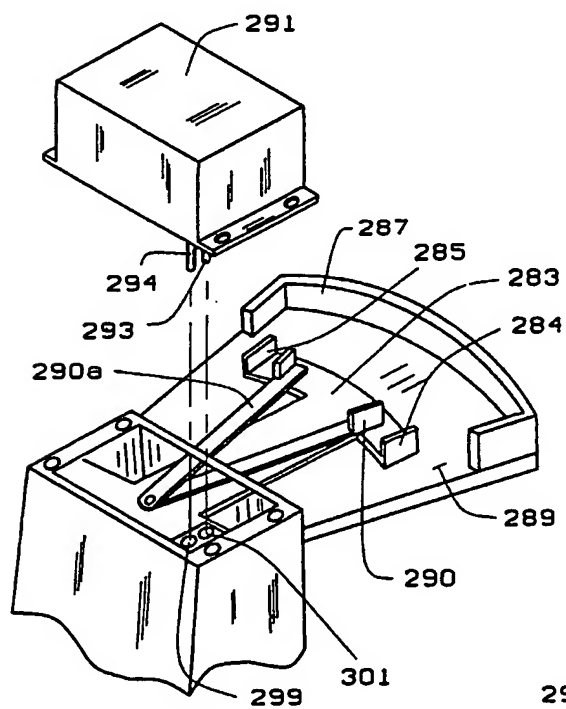


FIG. 26

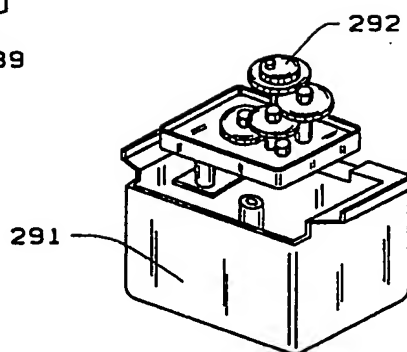


FIG. 27

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/08296

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :A63B 39/00

US CL :273/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 273/30, 29R, 29A, 29B, 26A, 26D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4,844,458 (Gatchel et al.) 04 July 1989 (entire document).	1-8
Y	US, A, 3,761,085 (Cook) 25 September 1973 (entire document).	1-8
X	US, A, 2,199,009 (Perryman) 30 April 1940 (entire document).	7
X	US, A, 4,735,405 (Marocco) 05 April 1988 (entire document).	7
A	US, A, 3,999,754 (Krzysztofiak et al.) 28 December 1976 (entire document).	10-17
A	US, A, 4,895,366 (Bartasius) 23 January 1990.	10-17

<input type="checkbox"/>	Further documents are listed in the continuation of Box C.	<input type="checkbox"/>	See patent family annex.
A	document defining the general state of the art which is not considered to be part of particular relevance	*T*	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
E	earlier document published on or after the international filing date	*X*	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
L	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*Y*	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
O	document referring to an oral disclosure, use, exhibition or other means	*Z*	document member of the same patent family
P	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 13 December 1993	Date of mailing of the international search report 15 FEB 1994
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer <i>Andrea Robinson</i> THEATRICE BROWN
Facsimile No. NOT APPLICABLE	Telephone No. (703) 308-0858